

QUIZ #2 Dr. Ebrahim A.Rahman

Sec. 2 Nov. 24th 2014

Name _____ **STD-ID** _____

The following formulae may be needed in the questions:

1. Bitrate $= 2 \times B \times \log_2 L.$

2. C $= B \times \log_2 (1 + SNR).$

3. dB $= 10 \times \log_{10} \frac{P_2}{P_1}.$

Q1. Read the questions carefully and select the best answer.

1) The ----- is the maximum number of bits that the link can contain in the same time.

- | | |
|---|---|
| <input type="checkbox"/> a. Bandwidth. | <input type="checkbox"/> d. Bandwidth-Product. |
| <input type="checkbox"/> b. Throughput. | <input checked="" type="checkbox"/> e. Bandwidth-Delay Product. |
| <input type="checkbox"/> c. Latency. | <input type="checkbox"/> f. Jitter. |

2) The ----- is a type of transmission impairment in which the signal loses strength due to the different propagation speeds of each frequency that makes up the signal.

- | | |
|--|--|
| <input type="checkbox"/> a. Attenuation. | <input type="checkbox"/> d. Coupling. |
| <input type="checkbox"/> b. Noise. | <input checked="" type="checkbox"/> e. Distortion. |
| <input type="checkbox"/> c. Cross Talk. | <input type="checkbox"/> f. Decibel. |

3) For a ----- channel, the Nyquist bit rate formula defines the theoretical maximum bit rate.

- | | |
|---|--|
| <input type="checkbox"/> a. Noisy. | <input type="checkbox"/> c. Both a and b. |
| <input checked="" type="checkbox"/> b. Noiseless. | <input type="checkbox"/> d. None of the above. |

4) The power of a signal is 0.1 W and the power of the noise is 0.1 mW. The value of SNR_{dB} is

- | | |
|--|-----------------------------------|
| <input type="checkbox"/> a. 10. | <input type="checkbox"/> d. 40. |
| <input type="checkbox"/> b. 20. | <input type="checkbox"/> e. 50. |
| <input checked="" type="checkbox"/> c. 30. | <input type="checkbox"/> f. 1000. |

Q2. Fill the blank with suitable words/numbers.

- 1) The performance of a telephone line is 4 kHz. When the signal is 20.47 V, the noise is 10 mV. The maximum data rate supported by this telephone is ----- kbps.

Sol:

$$SNR = \frac{20.47 \times 1000}{10} = 2047$$

$$C = B \times \log_2 (1 + SNR)$$

$$= 4000 \times \log_2 2048$$

$$= 4000 \times 11 = 44000 \text{ bps}$$

$$= 44 \text{ kbps}$$

- 2) A noiseless channel with a bandwidth of 3000 Hz is transmitting a signal with four signal levels. The maximum bit rate this channel can achieve is ----- kbps.

Sol:

$$\text{BitRate} = 2 \times \text{Bandwidth} \times \log_2 L$$

$$= 2 \times 3000 \times \log_2 4$$

$$= 12000 \text{ bps}$$

$$= 12 \text{ kbps}$$

- 3) A device is sending out data at the rate of 10000 bps. It takes it ----- ms to send out 10 bits of data.

Sol:

$$\text{Transmission time} = \frac{\text{Data Size}}{\text{Bandwidth}} = \frac{10}{10,000} = 0.001 \text{ s}$$
$$= 1 \text{ ms}$$

Q3. We need to send 640 kbps over a noiseless channel with a bandwidth 40 kHz. How many signal levels do we need?

Sol:

$$\text{BitRate} = 2 \times \text{Bandwidth} \times \log_2 L$$

$$640 = 2 \times 40 \times \log_2 L$$

$$\rightarrow \log_2 L = \frac{640}{80} = 8$$

$$\rightarrow L = 3.$$

Q4. Consider the following network path with 2 routers. The speed (bandwidth) and delay (propagation delay) of the link are as indicated in the figure. Assume that the path is completely empty initially.



- i. What is the total time required to transmit a 500 kB packet across this path? [assuming that the processing delay is zero]

Sol:

$$\text{Transmission time} = \frac{\text{Data Size}}{\text{Bandwidth}} = \frac{500 \times 1024 \times 8}{20 \times 1000 \times 1000 \times 1000} = 204.8 \mu\text{s}$$

$$\begin{aligned} \text{Total Time} &= \text{Transmission time} + \text{Propagation time} + \text{Queuing time} + \\ &\quad \text{Processing time} \\ &= 204.8 + 4000 + 0 + 0 = 4204.8 \mu\text{s} \end{aligned}$$

- ii. What is the maximum number of bits of data that this network path carries at any moment?

Sol:

$$\text{Propagation delay} = 4000 \mu\text{s} = 4000 \times 10^{-3} \text{ ms} = 4000 \times 10^{-6} \text{ s}$$

$$\text{Bandwidth} = 20 \text{ Gbps} = 20 \times 10^3 \text{ Mbps} = 20 \times 10^6 \text{ kbps} = 20 \times 10^9 \text{ bps}$$

$$\begin{aligned} \text{Bandwidth-Delay Product} &= \text{propagation delay} \times \text{bandwidth} \\ &= 4000 \times 10^{-6} \times 20 \times 10^9 = 8 \times 10^7 \text{ bits} \\ &= 10^7 \text{ Bytes} \end{aligned}$$

- iii. A MP3 file is roughly 4MB. How many MP3 files can the path carry at any moment.

Sol:

$$\begin{aligned}\text{Total MP3 files} &= \frac{\text{Bandwidth-delay product}}{\text{Size of MP3 file}} \\ &= \frac{10^7}{4 \times 1024 \times 1024} \cong 2.38 \text{ MP3 files.}\end{aligned}$$